

# **U. S. Dairy Forage Research Achievements: Past, Present and Future**

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**20<sup>th</sup> Anniversary Recognition  
Seminar**

**Fluno Center for Executive  
Education**

**University of Wisconsin**

**Neal P. Martin**

# Dairy Forage Research Solves Major Issues

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## ■ Dairy Farm Families

- Sustainable profit
- Improvement in quality of life
- Sustain the natural resource base



# U.S. Dairy Forage Research Center

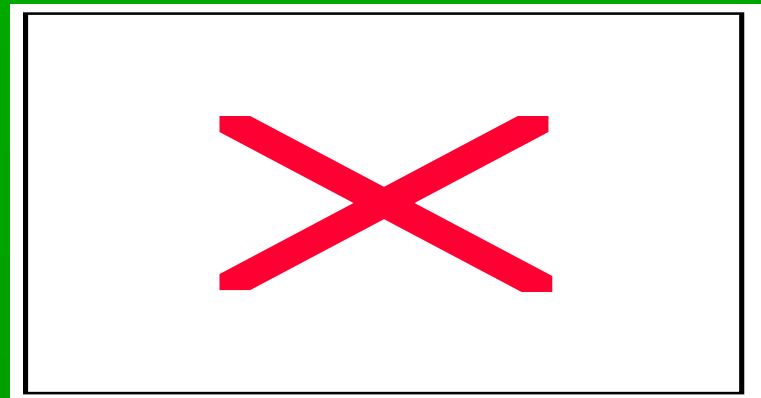
USDA, Agricultural Research Service



Research Lab, Madison, WI



Research Farm, Prairie du Sac,



- Serving an industry generating \$21 billion in annual milk sales
- Dairy cattle consume 100 million tons of forage valued at \$8 billion

- Unique interdisciplinary research team developing knowledge and tools needed to enhance sustainable and competitive dairy forage systems that protect the environment, promote animal health, and ensure a safe, healthy food supply.

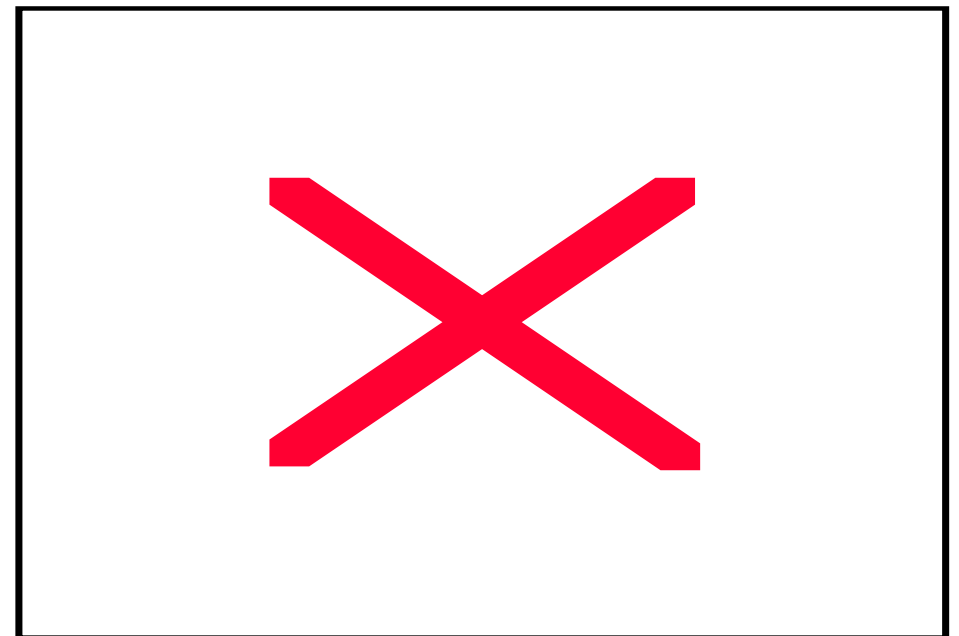
# U S Dairy Forage Research Center

## ■ Facilities

- Laboratory and Greenhouses, Madison
- Field Facility, Prairie du Sac

## ■ Scientists and staff

- Madison
- St. Paul, MN
- Ithaca, NY



# **U S Dairy Forage Research Center - Positions**

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- **4 Research Dairy Scientists**
- **1 Research Lignin Chemist**
- **2 Research Rumen Microbiologists**
- **1 Research Forage Geneticist/Plant Breeder**
- **1 Research Plant Physiologist/Biochemist**
- **1 Research Forage Agronomist/Management**
- **2 Research Agricultural Engineers**
- **1 Research Soil Scientist**



# U S Dairy Forage Research Center

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## Field Facility, Prairie du Sac

- 65 acres with dairy barns, storage buildings and office.
- Lease of land from BAAP
  - 400 acres alfalfa
  - 375 acres corn
  - 200 acres soybeans
  - 100 barley or oats
  - 250 acres pasture



# U S Dairy Forage Research Center

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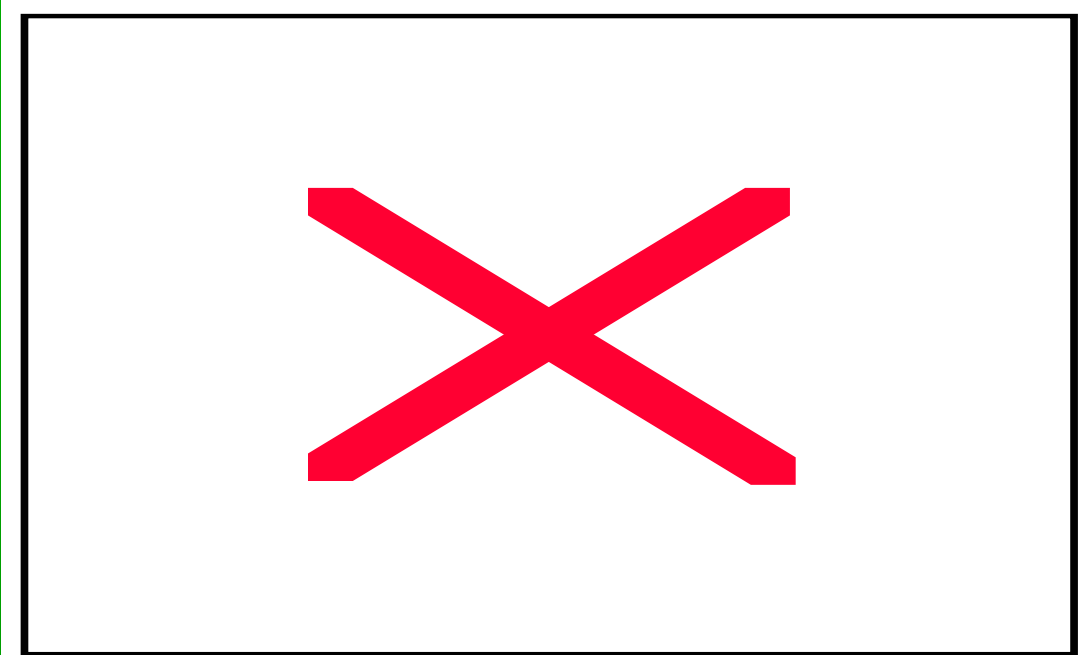
## Field Facility, Prairie du Sac

### ■ Personnel

- Manager/Agronomist
- Herdsman
- 25 employees

### ■ Livestock

- 320 milking cows
- 325 dry cows & replace



# U S Dairy Forage Research Center

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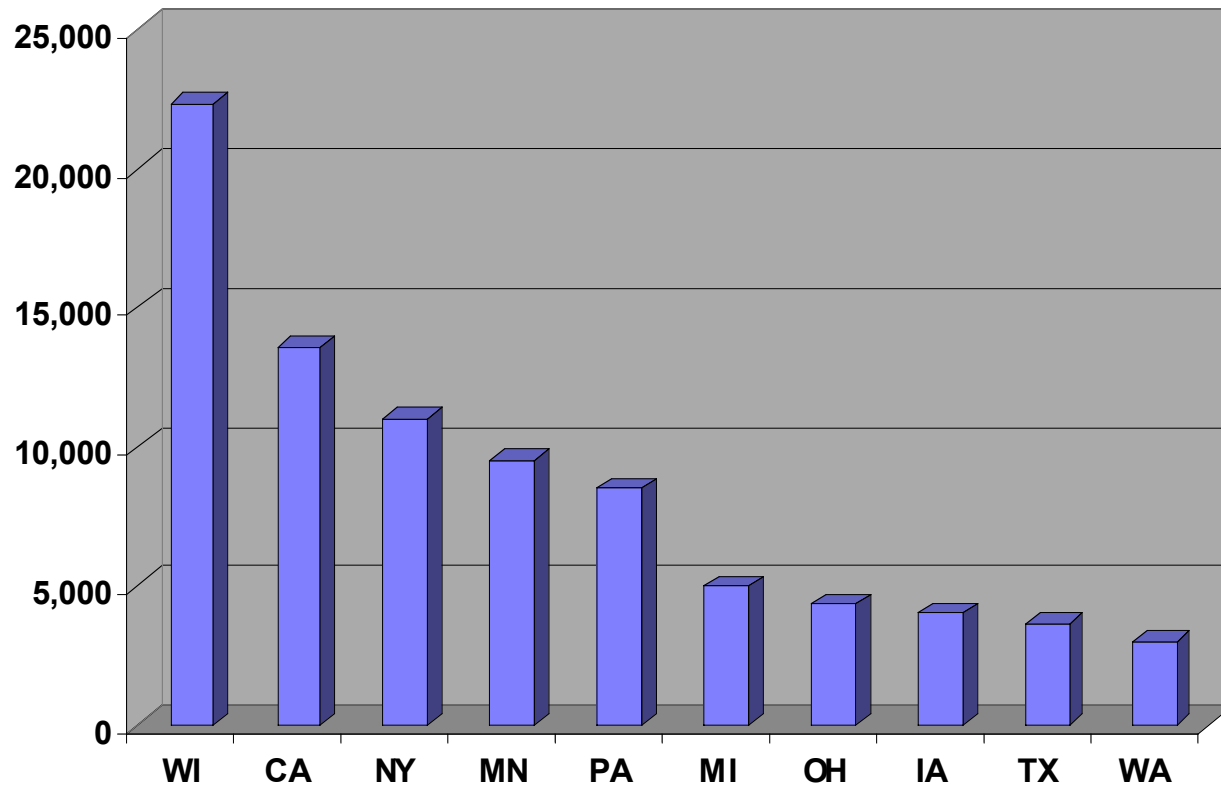
## Research Thrusts:

- Indigestibility and digestion kinetics of cell wall
- Use of site-specific estimates of nutritive value
- Value-added product development of legumes and manure
- Improving efficiency of nitrogen utilization
- Integrated cropping systems and nutrient management



# US Milk Production 1980

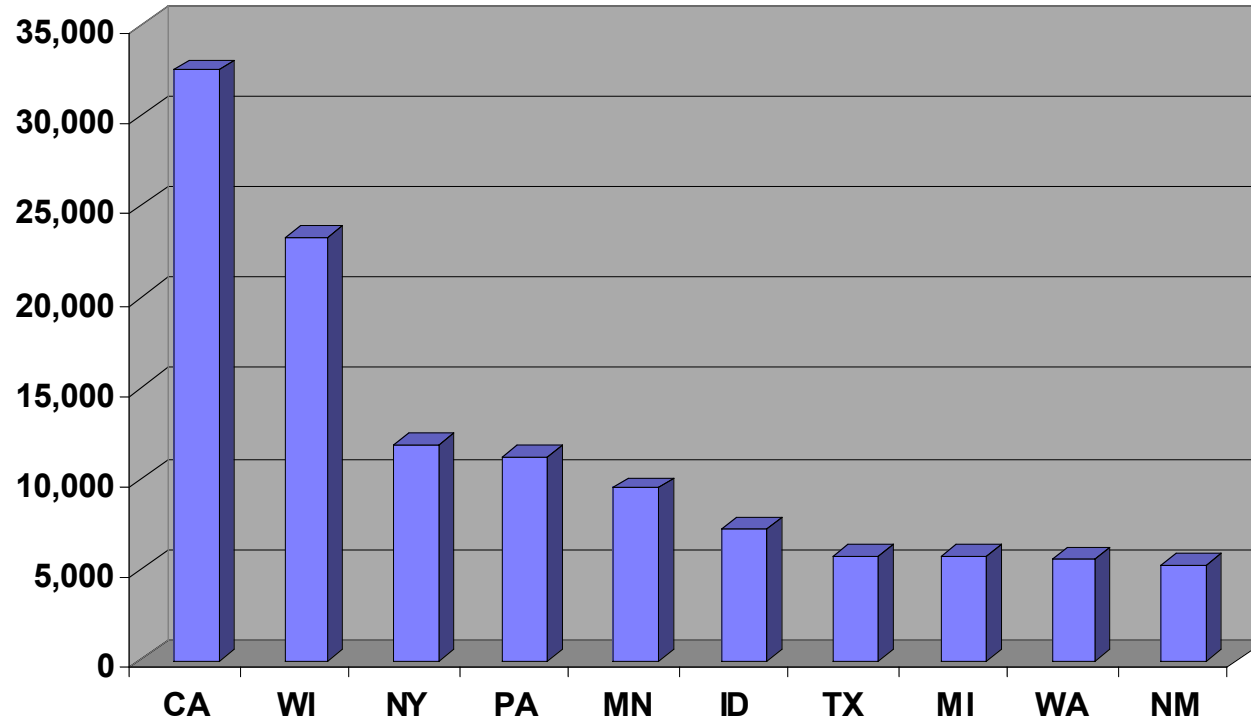
Annual Milk 10 top Dairy States, million lbs



- **Top 10 states**
  - 66 % of U. S.
  - 5 states NC
  - 3 states West
  - 2 states NE
- **Cow numbers**
  - 63 % of U. S.
- **Prod/cow**
  - 3.9 % above U. S. average

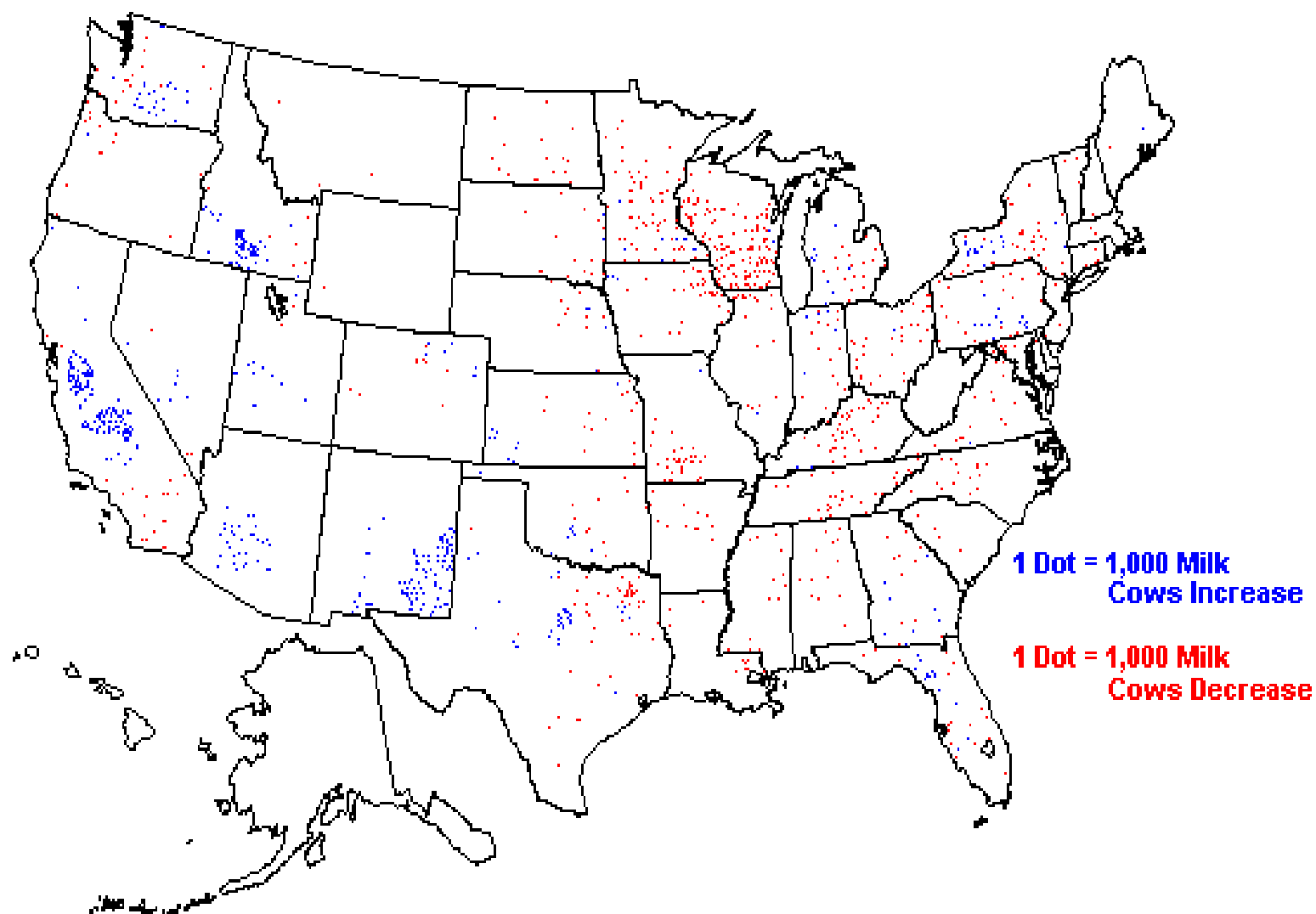
# US Milk Production 2000

Annual Milk 10 Top Dairy States, million lb



- **Top 10 states**
  - 70 % of U. S.
  - 5 states West
  - 3 states NC
  - 2 states NE
- **Cow numbers**
  - 67 % of U. S.
- **Prod/cow**
  - 5.4 % above U. S. average

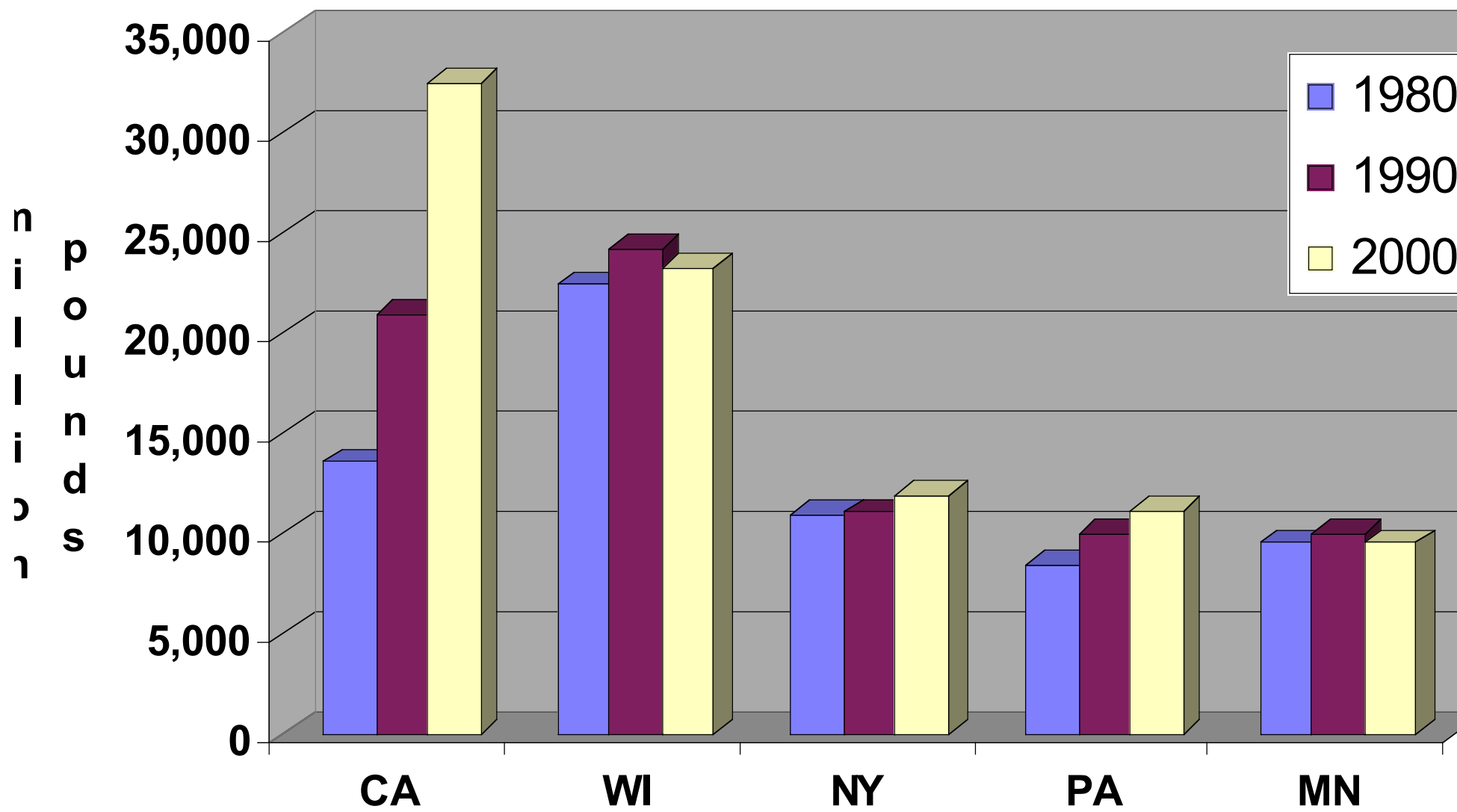
## Milk Cows - Change in Inventory: 1992 to 1997



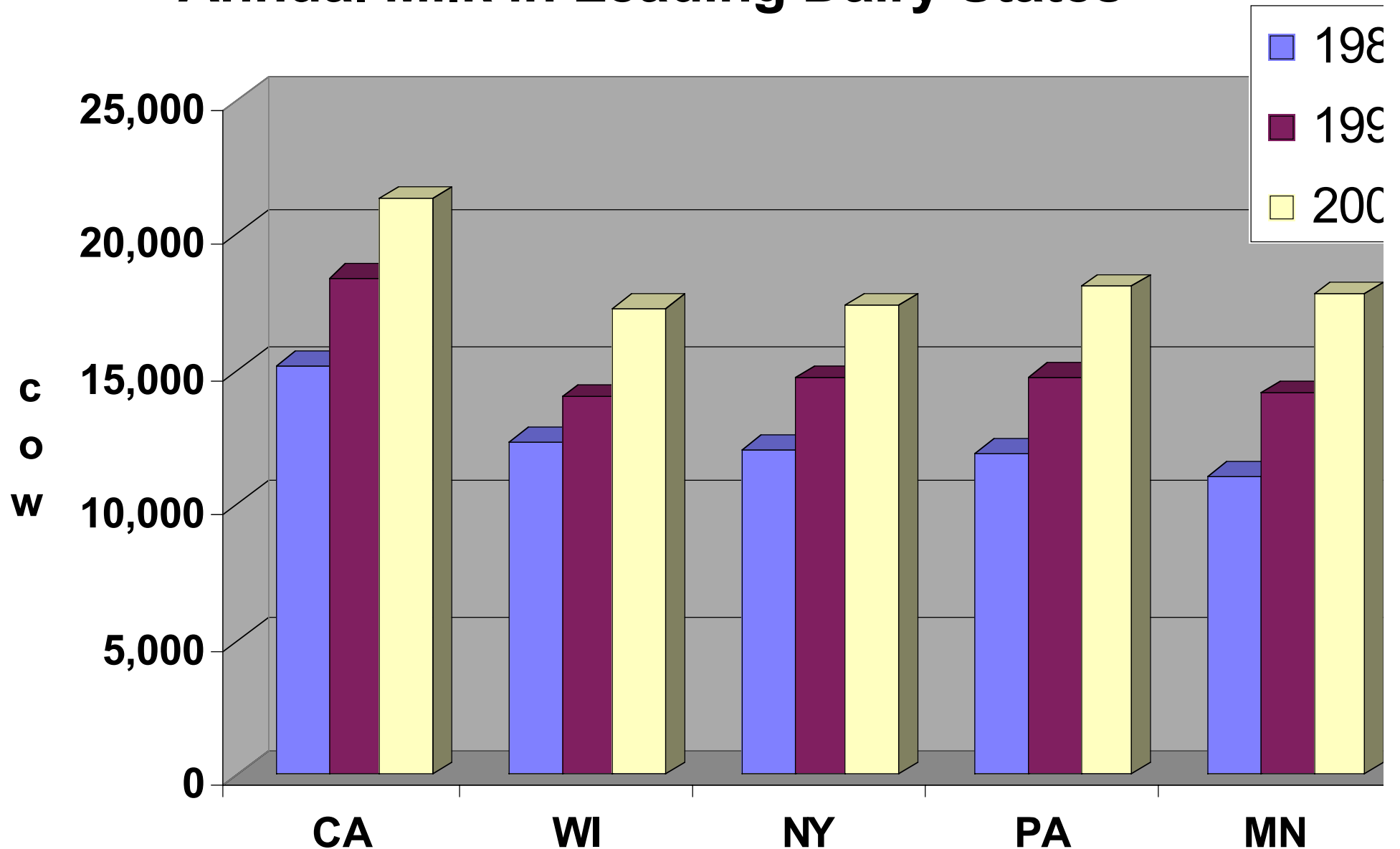
United States Net Decrease  
- 396,379

Source: 1997 Census of Agriculture

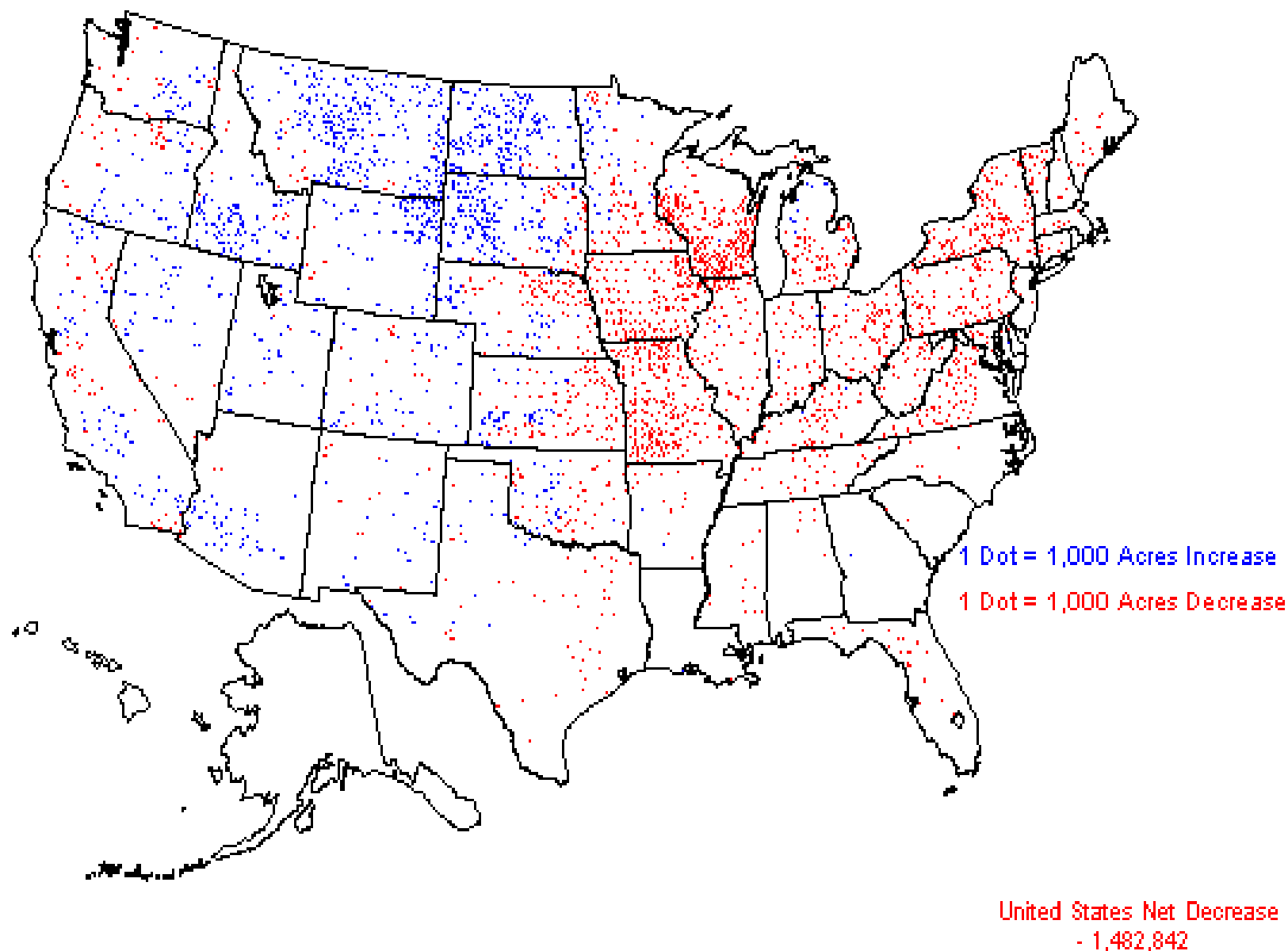
# Milk Production in Leading Dairy States



# Annual Milk in Leading Dairy States



## Alfalfa Hay Harvested - Change in Acreage: 1992 to 1997



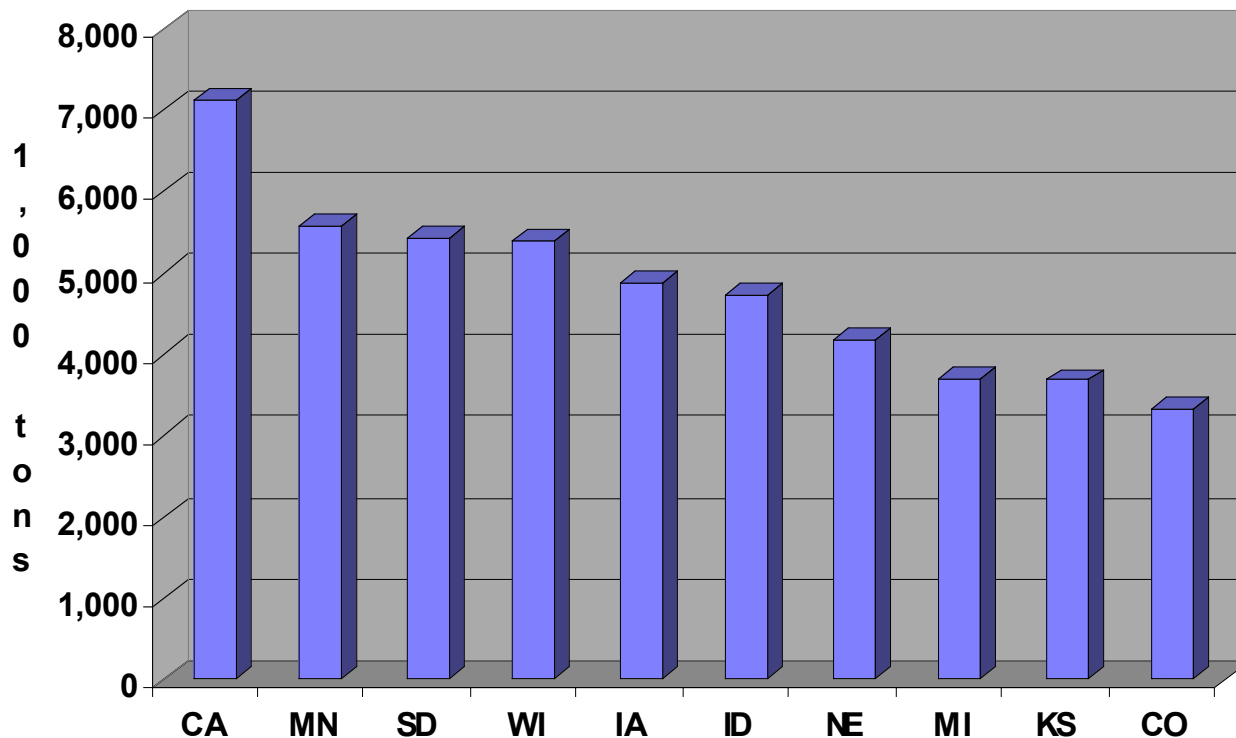
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Source: 1997 Census of Agriculture



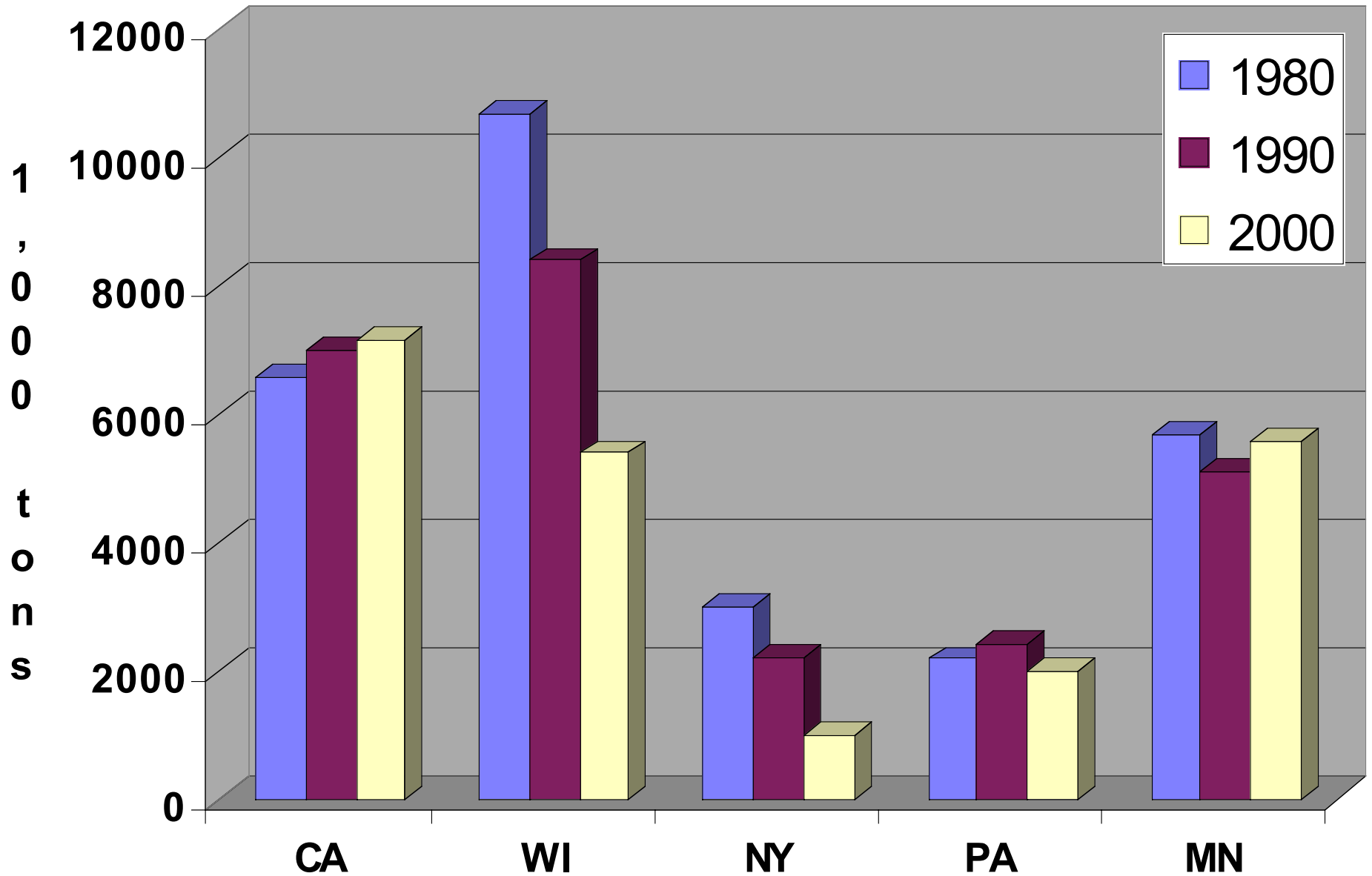
# US Alfalfa Hay Production 2000

Alfalfa Hay Production, Top States, 2000

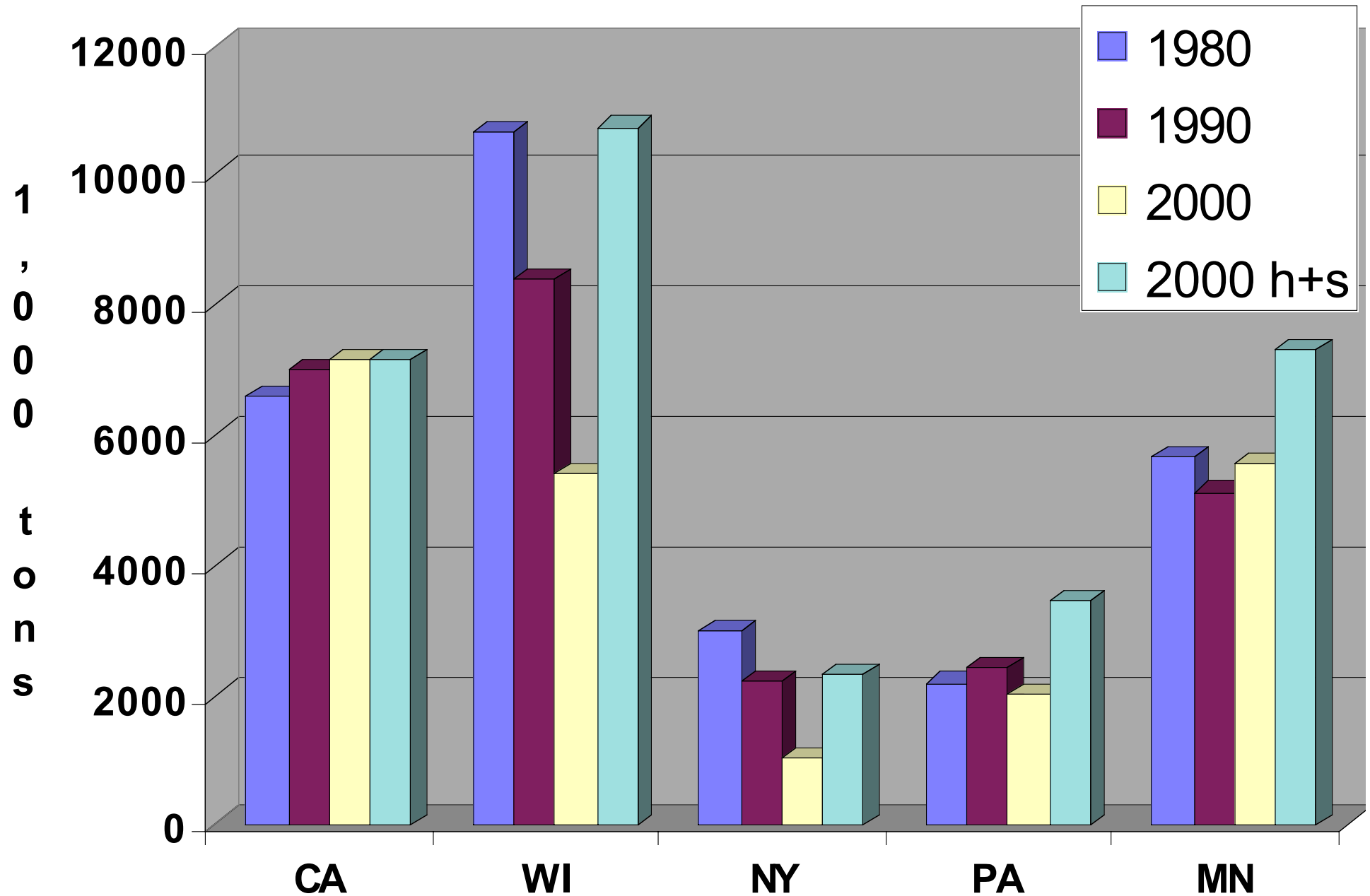


- **Top 10 states**
  - 60 % of U. S.
  - 6 states West
  - 4 states NC
- **Only 5 are top 10 dairy states**

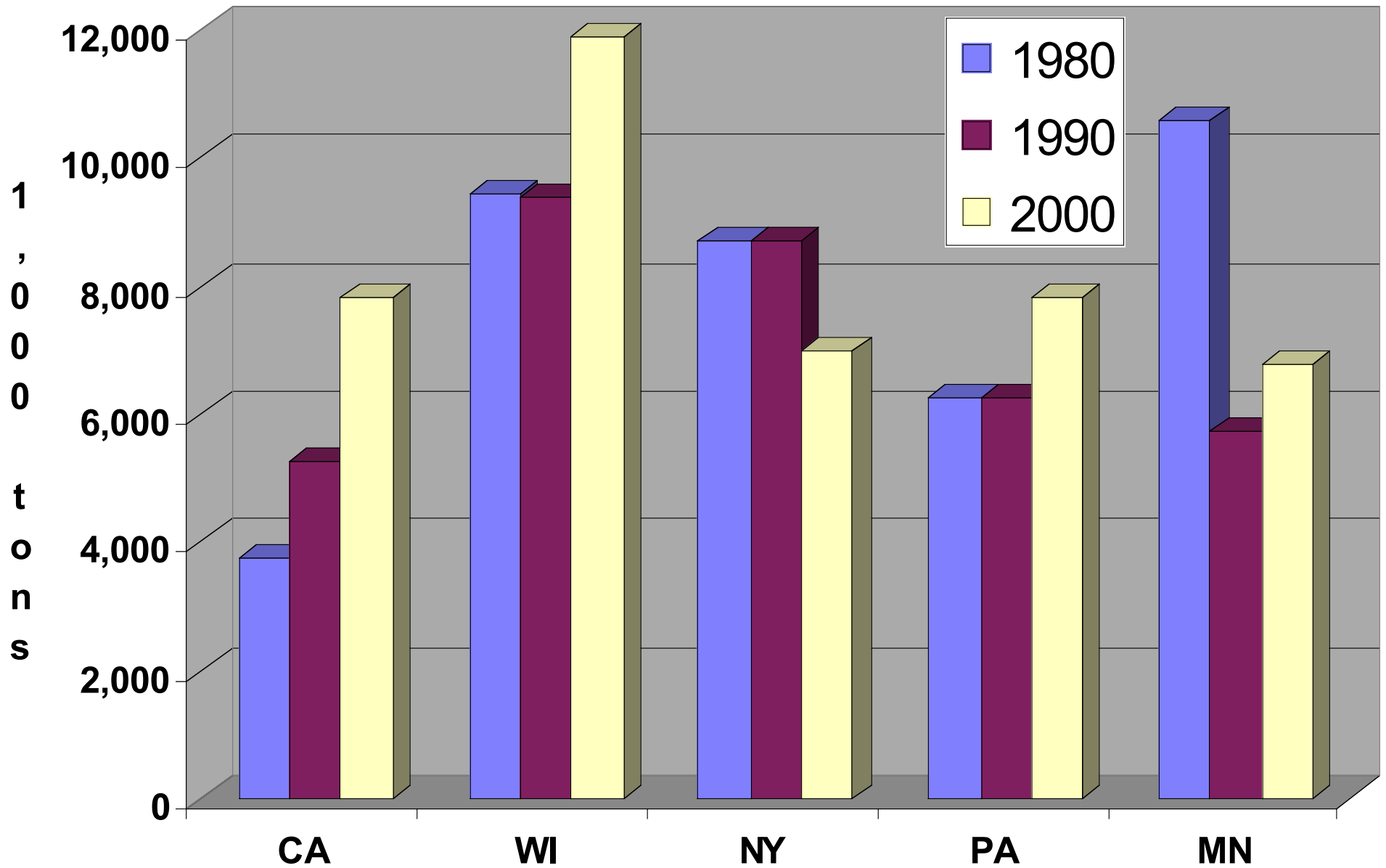
# Alfalfa Hay in Leading Dairy States



# Alfalfa in Leading Dairy States



# Corn Silage in Leading Dairy States



# Dairy Forage Use 1980 to 2001

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- Dairy farms are increasing in size, increasing output and concentrating around rapid population growth areas
- Dairy farms are changing management approaches. Forage uses:
  - Increased harvest capacity
  - More dairy operations rely on someone else to provide forage
  - Dairy operations in north central and north eastern U. S. are shifting to grazing, replacing equipment with cow harvesters and cow manure spreaders

# Dairy Forage Use 1980 to 2001

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- In 1980, successful dairy farms raised their own forage crops.
- Now dairy farmers can rely on others to provide forage
  - Quality hay which supports high cow performance can be defined and delivered
  - Forage testing is rapid, uniform and accurate
  - Custom harvesters can provide quality alfalfa and corn silage
  - Alfalfa hay is marketed based on quality standards
- Alfalfa and corn silage use are increasing



# Accomplishments of USDFRC Scientists and Collaborators

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- Improving forage-based rations
- Forage Production, Management and Storage
- Forage digestibility
- Forage and feed analysis
- Adding value to forage operations
- Forages and the environment

# IMPROVING FORAGE-BASED RATIONS

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- **Protein limits milk production of alfalfa silage diets**
  - roasted soybeans in dairy cow diets annually generates \$20 to \$40 million
  - Silage preservation increases protein
  - Grinding of corn and use of corn silage
  - Red clover contains enzyme which saves 30 % of protein during ensiling

# IMPROVING FORAGE-BASED RATIONS

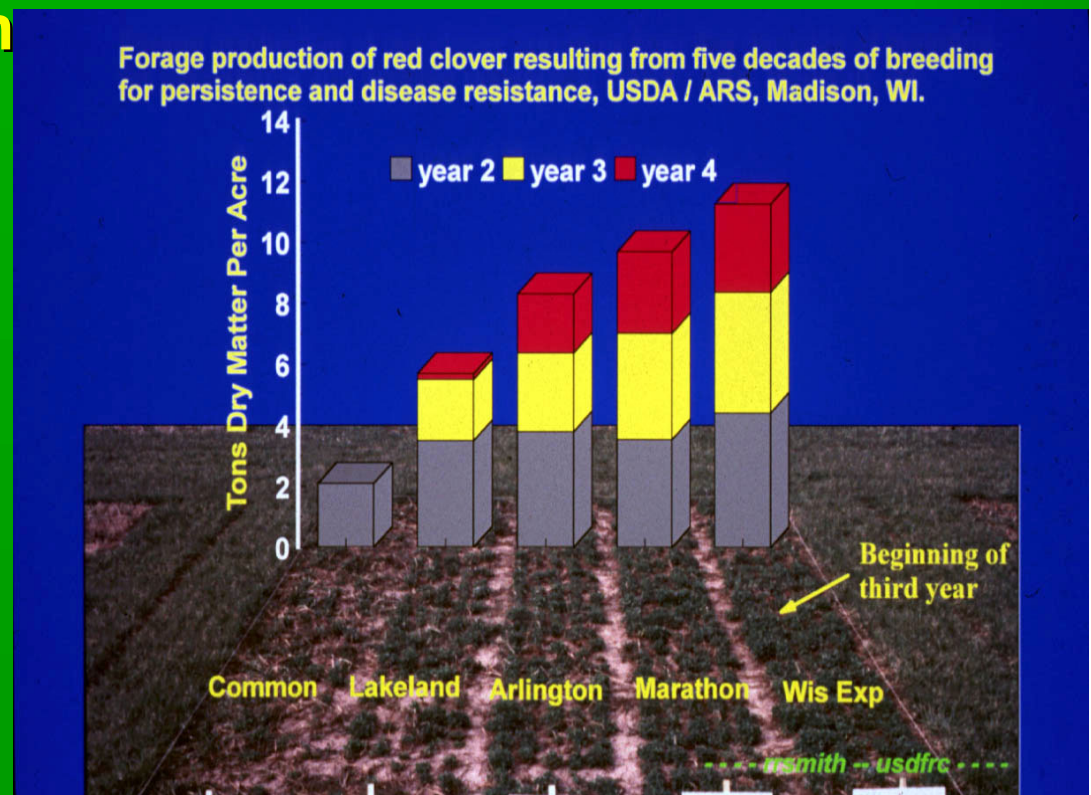
Judicious combination of forages with other feedstuffs provides the balanced diet necessary for production of high-quality milk.

- Cornell net carbohydrate protein system
- NDF-Energy intake system
- Physically effective fiber



# Forage Production – Legume Genetics

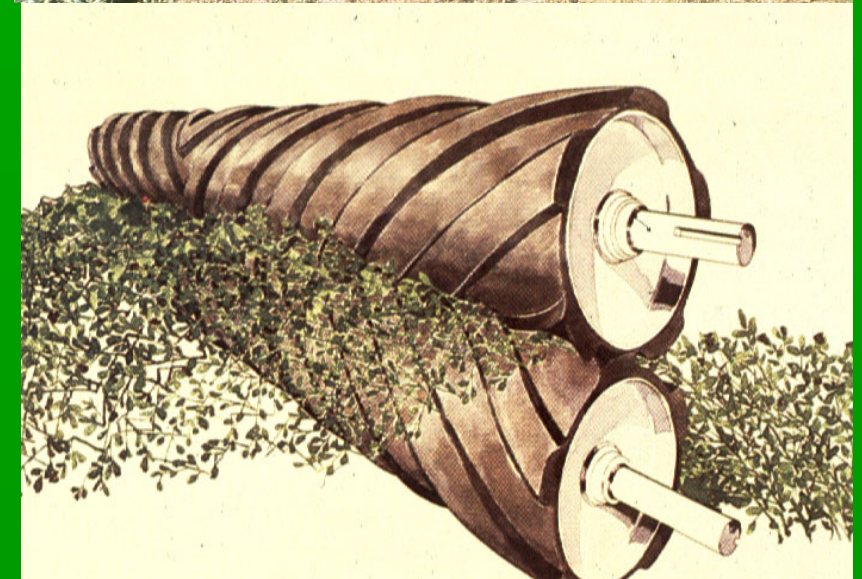
- Arlington and Marathon red clover were developed & released. These varieties have increased persistence, longevity, yields, and disease resistance. Annually save \$140/acre/year on at least 250,000 acres in the Midwest.



# Forage Harvest Management

**77 million acres are harvested as forage.**

- Quantify harvest losses and drying rates
  - potential savings could top \$4.4 million per year.
- DAFOSYM
  - **Whole farm DAiry-FORage SYstem Model**
  - **Research tool to prioritize variables**

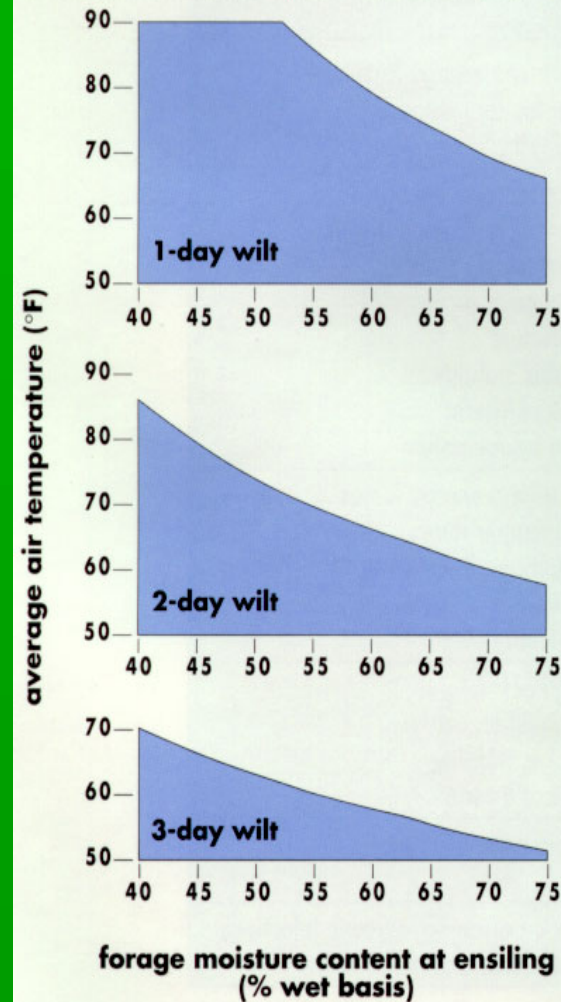




# Forage Storage – Silage Preservation

- Silage research
  - Economic use of bacterial inoculants

**Figure 20.** Conditions for profitable use of inoculant on silage. Shaded areas indicate profitable conditions.



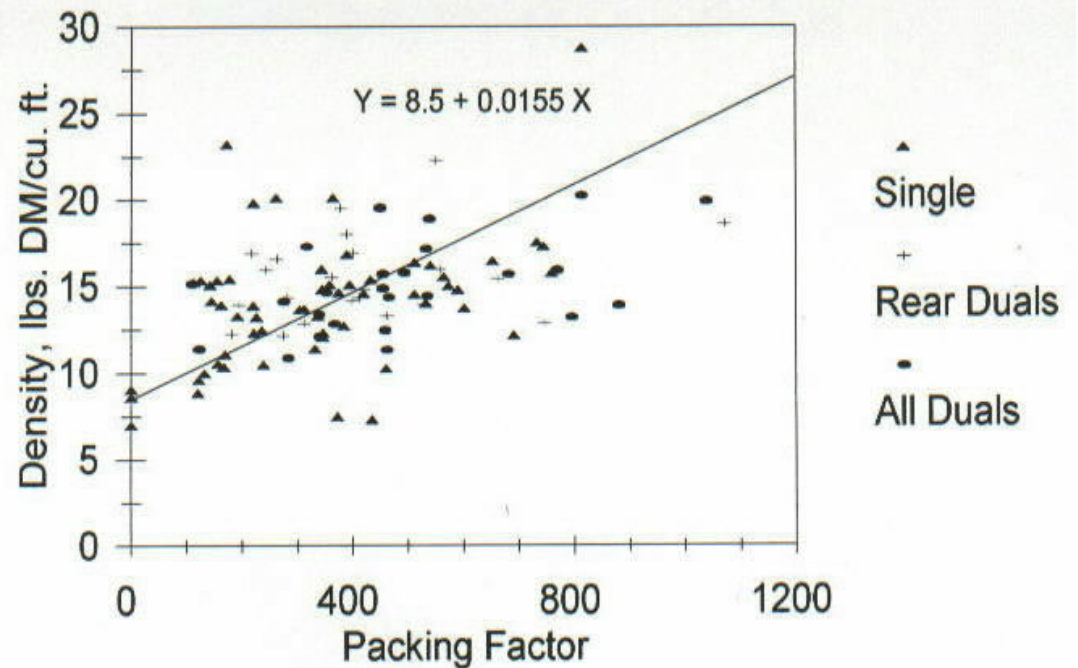
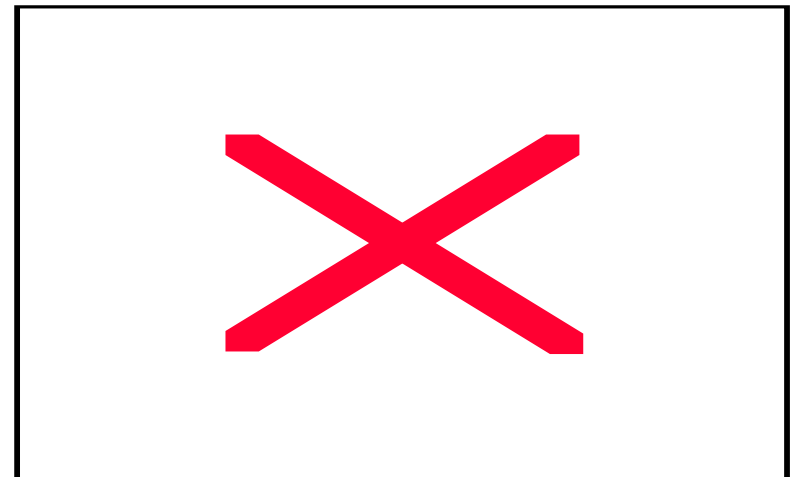
Source: Adapted from Muck, USDA, 1993



# Forage Storage – Silage Preservation

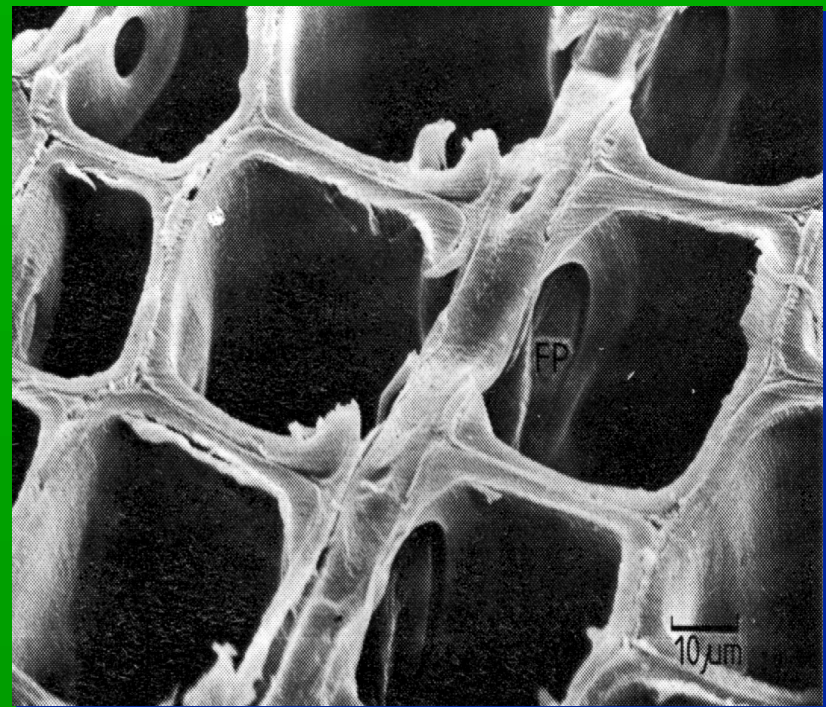
## ■ Silage research

- Economic use of bacterial inoculants
- Factors needed to obtain desired density of silage in bunkers



# FORAGE DIGESTIBILITY

- A 10% increase in cell wall digestion would result in an additional \$380 million in milk and meat sales while reducing manure solids by 2.8 million tons and grain input by 2.0 million tons.



# FORAGE AND FEED ANALYSIS

- Improving the speed and accuracy of analysis will allow farmers to make more informed decisions, and will provide researchers with information needed to improve forage varieties and forage management.





# ADDING VALUE TO FORAGE OPERATIONS

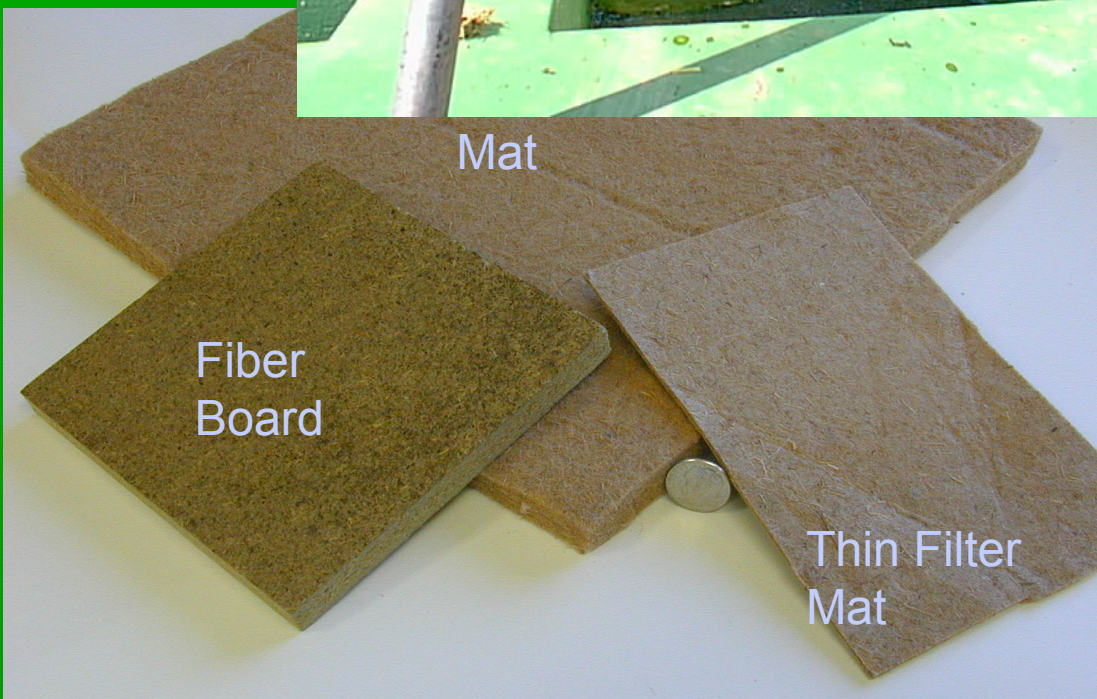
Farm profitability will be enhanced by forage processing advances:

- Novel mat maker
- Increases drying rates
- Increases fiber digestion
- Improves protein utilization



# ADDING VALUE TO FORAGE OPERATIONS

Farm profitability will be enhanced by forages that improve specific milk characteristics, or that serve as the starting material for production of bulk and specialty chemicals.



# FORAGES AND THE ENVIRONMENT

- Forage production has numerous positive impacts on soil fertility, water quality, wildlife habitat, and agricultural sustainability.

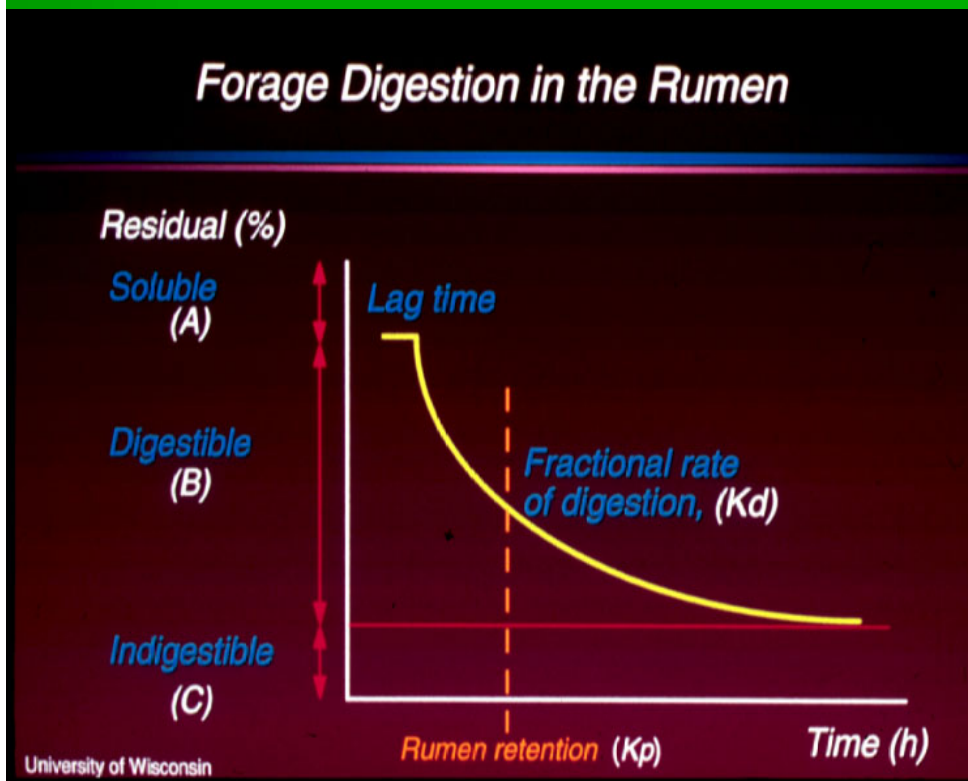


# Needs of Dairy Forage Industry

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- **Dairy Industry Under Utilizes Forage**
- **Current Limitations to Forage Utilization**
  - Digestibility of fiber
  - Degradation of protein in legume and grass silage
  - Prediction of forage and feed intake of lactating cows
  - Increase knowledge and understanding of N and P loading on dairy farms
  - Harvest and storage losses
  - Forage yield, persistence and quality
  - Grasses and legumes that extend grazing

# Digestibility of Fiber



## ■ Kinetic approach to digestibility is needed:

- *in vivo* research in support is needed
- fiber, starch, and DDM
- NIRS calibrations possible

## ■ Physical measures

# A Vision of The Future of Dairy Forage Research

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